Claims

1. A process for preparing an ionic compound comprising at least one cation containing a quaternary sp^2-hybridized nitrogen atom, which comprises

    a) reacting a compound containing a double-bonded nitrogen atom with a dialkyl sulfate with participation of both alkyl groups of the dialkyl sulfate to give an ionic compound containing sulfate anions, and

    b) if appropriate, subjecting the ionic compound obtained in step a) to an anion exchange.

2. The process according to claim 1, wherein the cation is derived from imines, diazines, amidines, amidoximes, amidrazones, oximes, sulfimides, guanidines, phosphinimines or nitrogen-containing aromatic heterocycles.

3. The process according to claim 1 or 2, wherein the ionic compound obtained comprises at least one anion X^{n-} in which n is an integer corresponding to the valence of the anion and which is selected from among SO_4^{2-}, HSO_4^-, NO_2^-, NO_3^-, CN^-, OCN^-, NCO^-, SCN^-, NCS^-, PO_4^{3-}, HPO_4^{2-}, $H_2PO_4^-$, $H_2PO_3^-$, HPO_3^{2-}, BO_3^{3-}, $(BO_2)_3^{3-}$, $[BF_4]^-$, $[BCl_4]^-$, $[B(C_6H_5)_4]^-$, $[PF_6]^-$, $[SbF_6]^-$, $[AsF_6]^-$, $[AlCl_4]^-$, $[AlBr_4]^-$, $[ZnCl_3]^-$, dichlorocuprates(I) and (II), CO_3^{2-}, HCO_3^-, F^-, $(CF_3-SO_3)^-$, R'_3SiO^-, $R'-SO_3^-$ and $[(R'-SO_2)_2N]^-$, where R' is alkyl, cycloalkyl or aryl.

4. The process according to any of the preceding claims for preparing compounds of the formula II

$$\left[R^1-N \begin{array}{c} Z^1 \quad Z^2 \\ | \quad + \quad | \\ \diagdown \diagup Y^2 \\ Y^1 \end{array} \right]_n X^{n-}$$

(II)
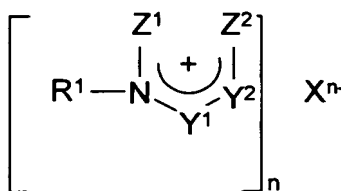
where

R^1 is C_1-C_{10}-alkyl,

Y^1 and Y^2 are selected independently from among heteroatoms and heteroatom-containing groups which each have a free electron pair and groups CR^2 in which the carbon atom is sp^2-hybridized and R^2 is hydrogen or an organyl radical,

Z^1 and Z^2 are each, independently of one another, a single- or double-bonded organyl radical, where Z^1 and Z^2 may also together form a bridging group having from 2 to 5 atoms between the flanking bonds,
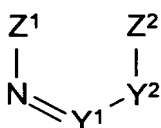
X^{n-} is an anion which is preferably not Cl^-, Br^-, I^- or monoalkylsulfate, and

n is an integer from 1 to 3,

where the group NR^1-Y^1-Y^2 and, if appropriate, also Z^1 and/or Z^2 are part of a delocalized π electron system,

wherein

a) a compound of the general formula II.1

$$\begin{array}{cc} Z^1 & Z^2 \\ | & | \\ N\!\!\diagdown_{Y^1}\!\!\diagup^{-Y^2} \end{array}$$

(II.1)

where Y^1, Y^2, Z^1 and Z^2 are as defined above, is reacted with a dialkyl sulfate $(R^1)_2SO_4$, where R^1 is C_1-C_{10}-alkyl, at elevated temperature with participation of both alkyl groups of the dialkyl sulfate to form a compound of the formula II in which X^{n-} is a sulfate anion, and

b) if appropriate, the sulfate anion is exchanged for a different anion.

5. The process according to claim 4, wherein the groups Y^1 and Y^2 in the formulae II and II.1 are selected independently from among O, S, CR^2, NR^3 and PR^4, where R^2, R^3 and R^4 are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, $COOR^a$, COO^-M^+, SO_3R^a, $SO_3^-M^+$, sulfonamide, NE^1E^2, $(NE^1E^2E^3)^+A^-$, OR^a, SR^a, $(CHR^bCH_2O)_yR^a$, $(CH_2O)_yR^a$, $(CH_2CH_2NE^1)_yR^a$, alkylaminocarbonyl, dialkylaminocarbonyl, alkylcarbonylamino, halogen, nitro, acyl or cyano, where

the radicals R^a are identical or different and are selected from among hydrogen, alkyl, cycloalkyl, aryl, heterocycloalkyl and hetaryl,

E^1, E^2, E^3 are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl, aryl and hetaryl,

R^b is hydrogen, methyl or ethyl,

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M^+ is a cation equivalent,

A^- is an anion equivalent and

5   y   is an integer from 1 to 250.

6.   The process according to claim 4 or 5, wherein Z^1 and Z^2 together form a bridging group having two or three atoms between the flanking bonds, which are selected from among optionally substituted heteroatoms and sp^2-hybridized

10   carbon atoms, with the bridging group together with the group NR^1-Y^1-Y^2 forming a delocalized π electron system.

7.   The process according to any of claims 4 to 6, wherein the compound of the formula II is selected from among compounds of the formulae II.a to II.e

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(II.a)   (II.b)

20   (II.c)   (II.d)

(II.e)
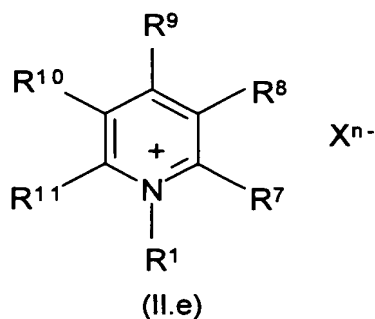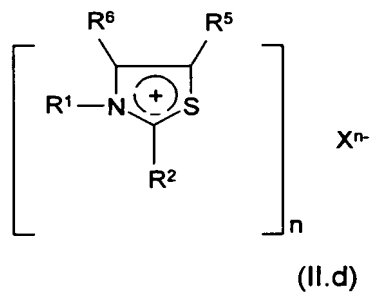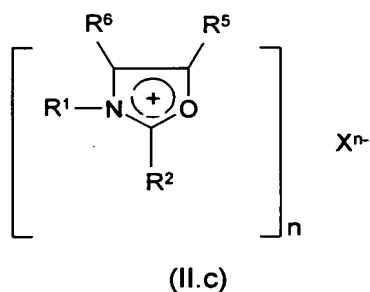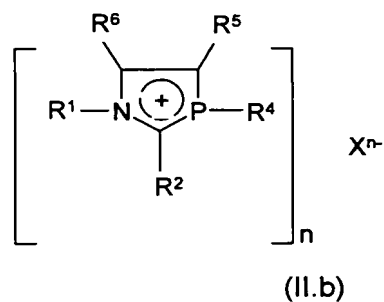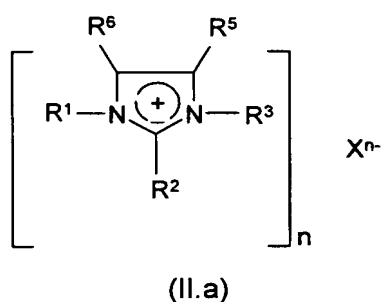
25   where

X^{n-} is an anion which is preferably not Cl^-, Br^-, I^- nor monoalkylsulfate, and

n   is an integer from 1 to 3,

R^1 is C_1-C_{10}-alkyl, and

R^2, R^3, R^4, R^5, R^6, R^7, R^8, R^9, R^{10} and R^{11} are each, independently of one another, hydrogen, alkyl, cycloalkyl, heterocycloalkyl, aryl, hetaryl, $COOR^a$, COO^-M^+, SO_3R^a, $SO_3^-M^+$, sulfonamide, NE^1E^2, $(NE^1E^2E^3)^+A^-$, OR^a, SR^a, $(CHR^bCH_2O)_yR^a$, $(CH_2O)_yR^a$, $(CH_2CH_2NE^1)_yR^a$, alkylaminocarbonyl, dialkylaminocarbonyl, alkylcarbonylamino, halogen, nitro, acyl or cyano, where

the radicals R^a are identical or different and are selected from among hydrogen, alkyl, cycloalkyl, aryl and hetaryl,

E^1, E^2, E^3 are identical or different radicals selected from among hydrogen, alkyl, cycloalkyl, aryl and hetaryl,

R^b is hydrogen, methyl or ethyl,

M^+ is a cation equivalent,

A^- is an anion equivalent and

y   is an integer from 1 to 250.

8.   The process according to any of the preceding claims, wherein the reaction in step a) is carried out at a temperature of at least 60°C, preferably at least 80°C, in particular in the range from 100 to 220°C.

9.   The process according to any of the preceding claims, wherein the molar ratio of the compound containing a double-bonded nitrogen atom to the dialkyl sulfate is at least 2:1.

10.   The process according to any of the preceding claims, wherein the reaction in step a) is carried out in an organic solvent, in water or in a mixture thereof.

11.   The process according to claim 10, wherein the solvent comprises at least 30% by volume of water.

12.   The process according to any of the preceding claims, wherein the reaction in step a) is carried out in the presence of an inert gas.

13. The process according to any of the preceding claims, wherein the dialkyl sulfate is selected from among dimethyl sulfate and diethyl sulfate.

14. The process according to any of the preceding claims, wherein the process steps a) and b) are carried out in the absence of halide ions.

15. The process according to any of the preceding claims, wherein the exchange of the sulfate anion in step b) is effected by transprotonation with H_2SO_4, reaction with a metal salt, ion exchange chromatography or a combination thereof.

16. The process according to claim 15, wherein the reaction with the metal salt is carried out in a solvent from which a metal sulfate formed from the metal of the metal salt and the sulfate anion crystallizes out.

17. A halide-free and monoalkylsulfate-free salt of the general formula I

$$b \, B^{m+} \, x \, X^{n-} \quad (I)$$

where

B^{m+} is an m-valent cation containing at least one quaternary sp^2-hybridized nitrogen atom,

X^{n-} is an n-valent anion,

b and x are integers ≥ 1, with the proviso that (b times m) = (x times n).

18. The use of a salt as defined in claim 17 as intermediate for preparing ionic liquids and as components and for the preparation of components for pharmaceutical preparations.